CHAPTER ONE INTRODUCTION

1.1 Introduction

Man lives in an environment, which nurtures and supports his every need. His major needs include food, water, air, developing shelter and living space, providing mobility and searching for a certain aesthetic quality of life for himself and others. The needs in man's life are satisfied through the activities as generally outlined in Table 1.1.

Table 1.1: Wastes generated via various activities and needs

Needs	*Activity*	*Typical Waste*
Food	Agricultural and food processing Industry	Food covering, excess water, spoiled foods, packaging waste, treatment chemicals.
Water	Water supply, regulation control.	Excess water solids, waste treatment, chemical sludge
Shelter	Power, flood control, land modification, regulatory and housing agencies	Waste materials, land and landscaping waste, Transportation waste.
Space and Mobility	Transportation industries and agencies	Fuel and transportation waste, construction wastes,
Aesthetic	Recreation, scenic and appreciation	Debris

All human activities end up with production of a wide variety of wastes, ranging from domestic refuse to highly toxic industrial waste. As the urban population density in

cities increased waste disposal became a profound problem (Douglas, 1977). The primary objective then was the removal of the refuse away from human population.

1.2 General solid waste generation

Economic progress, and the population increase in the developed and developing countries had led to an increase in the amount of waste produced per person (Phillips, 1997). The solid waste generation per person in selected countries is shown in Table 1.2.

Table 1.2: Solid waste generation per person in selected countries

Country	Kg/person /day (a)	Area 1995 (10^3 km^2) (b)	Population (1993 per km^2) (b)	Density (1993 per km^2) (b)	Population % 1998 (b)	GDP Per capita 1993 ($U.S.A) (b)
Nepal	0.25	147	20.4	28	74	190
Myanmar	0.25	677	43.5	66	24.6	n.a
India	0.33	3287	188	304	28	300
Bangladesh	0.35	144	122.3	939	13.6	220
Sri Lanka	0.42	66	17.8	275	21.4	600
Thailand	0.45	513	58.3	114	22.6	2110
Philippines	0.50	300	65	218	42.4	850
Taiwan	0.50	36	21	583	75	1110 (c)
Indonesia	0.60	1905	188	104	29	740
France	0.72	544	65	105	741	22490
Malaysia	0.76	330	19	58	42.3	3140
Sweden	0.79	450	8.7	21	84	24740
Hong Kong	0.85	1	5.9	5960	93.2	18060
Singapore	1.00	0.6	2.8	4590	100	19850
UK	1.00	245	58	240	92.5	18060
Canada	0.83	9976	28.1	3	76.4	19970
USA	2.10	9373	257	28	74	24740
Europe	0.96	4879	505	103	73	-
Japan	1.12	378	124.9	332	77	31490

SOURCE: (a) Agamuthu, 1997, Lecture notes on Environmental Management
(b) World Atlas, 1998, (C) 1991, n.a : not available

The modern society, which is regarded as rational, western, dynamic, profit orientated and a product of colonial import generates more municipal waste than traditional society. The more urbanized and affluent the community, the more complex and increased volume of wastes generated.

1.3 Solid waste generation rate in Malaysia

The rate of generation varied greatly depending on the premises (house, shop, food stalls and restaurant), affluence of the population (low income or high income), occupation or business. The Malaysian population is 23.2 million (2000) and is projected to increase to 28.9 million in 2010, at an average growth rate of 2.2 percent per annum (The Star, 11/7/2000). Taking up their share of space, the national density levels rose from 42 to 56 and 66 persons per square kilometer (km^2) in 1990, 1991 and 1997. In Federal Territory packed in over 5, 600 city dwellers per km^2, Penang had 1,083 people per km^2, and Melaka at a comfortable of 321 people per km^2. These demographic changes will have a significant impact on the solid waste generation rate in year 2010. The working age population is projected to increase to 62.9 percent in 2000 to 65.7 percent in 2010. With an average labour force growth of 3.1% per annum, the unemployment rate is expected to drop from 3.1% in 2000 to 2.5% in 2010. This will result in increased employment-from 9.3 million in 2000 to 12.6 million in 2010. The size of the labour force is expected to increase by 3.3 million to 12.9 million in 2010. This is attributed to increases in the size of the working age population (15-64 years) and

in the labour force participation rate. These fast growing rates will have a significant impact on the solid waste generation rate in the year 2010. The poverty was reduced from 16.5% in 1990 to 7.5% in 1999. The number of poor households dropped by 39% to 351, 000 in 1999 while the incidence of hardcore poverty fell from 3.9% to 1.4% in 1999. There was a steady increase in the overall quality of life with the "Malaysian Quality of Life Index" improving by 12 points (The Star, 4/4/2001: page 7). The increase in urban population rates had increased the volume of waste generation in six main states in Peninsular Malaysia. Malaysia, likely many developing countries in the world, places a high priority on economic development. Through a series of Five-Year Plans, its economy has greatly expanded. The per capita income increased at an average yearly rate of 7.8% to double from RM 6, 298 to RM 13, 359 at the end of OPP2 period (2nd Outline Perspective Plan). Gross Domestic Product (GDP) grew at an annual rate of 6 percent in 1980s and grew at an average rate of 7.5 percent during the 3rd Outline Perspective Plan Period (years) (The Star, 4/4/2001). Malaysia's rapid growth in recent years, has led to a pattern of high consumerism. Economic policies placed greater emphasis on growth, structural adjustment and the liberalization of the economy. Privatisation was given strong emphasis, and liberal investment policies were introduced to accelerate the growth of private investment and entrepreneurship. During the OPP2 period, the manufacturing sector led economic grow by posting a yearly growth of 10.4% Imports grew at an average yearly rate of 14.7%. During the period (1990-1999), total factor productivity (TFP) in the manufacturing sector grew nearly 5.1%. Food and

beverage, furniture, textile, general and electrical machinery were among the items recording higher TFP growth. These changes will have a significant impact on the solid waste generation.

Malaysian society has been progressively becoming a throwaway society as the packaging and industrial sectors had been growing and producing goods that are either discarded after a single use or have built-in obsolescence (Gurmit Singh, 1991). One direct consequence of such increase in consumption is the increase in the amount of solid waste. The national solid waste generation data in 1998 indicates that Malaysians generate approximately 15.2 tonnes of waste per day by an estimated population of 16.8 million people. The amount of municipal solid waste was expected to increase as the population increase, changing in life style and increasing use of disposal materials. Table 1.3 shows that residents in Selangor and Federal Kuala Lumpur generate more municipal solid waste.

In 1995, the total amount of solid waste generated throughout Malaysia was 5.5 million tonnes and of this 80% was domestic waste (about 12,000 tonnes/day) and the rest (about 3,000 tonnes/day) was commercial waste. Currently each urban Malaysian produced 1.20 kg of waste per day. The amount of municipal solid waste generation had increased from 246,006 tonnes (1997) to 249,563 tonnes (1998), commercial waste from factories, had declined from 98,976 to 70, 458 tonnes within the same period (NST, 8/6/1999). The national solid waste generation increased from 2.5 million tonnes in 1991 to 3.9 million tonnes in 2000 (Table1.4).

Table: 1.3: Estimated solid waste generation in Malaysia

State	Estimated Population	Waste Generated (tonnes/day)	Amount collected (tonnes/day)
Selangor	4,175.0	2375	1900
Kuala Lumpur	1,370.3	2500 **	2023
Sabah	2,656.4	1481	1037
Sarawak	2,071.8	1405	984
Perak	2,109.7	1295	906
Johor	2,721.9	1290	903
Kedah	1,652.0	1265	885
Penang	1,307.6	1033	723
Kelantan	1,314.6	833	583
Pahang	1,290.0	508	358
Melaka	634.1	489	342
Terengganu	899.0	467	327
N.Sembilan	858.9	462	323
Perlis	204.5	62	43
Labuan	112.6	46	32
Total	23,378.4	25268	11369

SOURCE: MHLG, 1999
** in year 2000

Table: 1.4: Solid waste generation rates in Malaysia

Year	Population (million) Increase-3%/year)	Waste generation rate (kg/cap/day) (increase at 2% /cap/year)	Total amount (million tonnes)
1991	13.272	0.7	2.5
1992	14.139	0.7	2.6
1993	14.563	0.7	2.8
1994	15.000	0.8	2.9
1995	15.450	0.8	3.0
1996	15.913	0.8	3.2
1997	16.391	0.8	3.4
1998	16.882	0.8	3.5
1999	17.389	0.8	3.7
2000	23 239	1.2	3.7

The total solid waste generated by all sectors (domestic, commercial and industry) in Kuala Lumpur since 1990 until 1996 is increasing because of the increasing squatter settlements and economic opportunites. A resident in Klang Valley generates about 3500 tonnes daily. One quarter of the total solid waste generated in the Klang Valley is from Selangor state. The average waste generation rates by different waste generators in Petaling Jaya are presented in Table 1.5. In the mid-1990s studies by various academic and non-governmental organisations had reported that the waste generation is closely related to overall economic levels and types of waste generators from which it originates (Table 1.5) (Sahabat Alam Malaysia, 2001). The daily garbage heap in Malaysia rivals the output of several European countries. So in terms of solid waste the nation has already developed into a mess on par with global standards.

Table 1.5: The average waste generation rate in Petaling Jaya based on source

Type of waste generators	Average waste generation rate	
Low Income Residential	2.76 kg/du/cd	0.46 kg/p/cd
Medium Income Residential	1.96 kg/du/cd	0.37 kg/p/cd
High Income Residential	3.18 kg/du/cd	0.6 kg/p/cd
Squatter	3.42 kg/du/cd	0.57 kg/p/cd
Shops	2.25 kg/shops/cd	
Shopping complexes	0.004 kg/sq.ft/cd	
Institutional	70 kg/ha/cd	
Industrial	440 kg/ha/cd	5 kg/employee/cd
Wet markets	3.92 kg/stalls/cd	
Night markets	1.3 kg/stalls/cd	
Hawker stalls	2 kg/stalls/cd	
Office compleks	0.002 kg/sq.ft/cd	
Hotels	0.9 kg/room/cd	

SOURCE: MPPJ,1998

In a 20 –year period (1970-1991), the urban masses almost doubled from 27% share to a 51% share of the population (Sahabat Alam Malaysia, 2001). The rapid increase in urban population; 6.5 million people (66 person per km ^{2}) live in urban, is one of the causes of an increase in solid waste generation in densely populated areas such as in Kuala Lumpur. The urban sprawl is spreading and getting more crowded in Pantai Dalam. Coupled with changes in lifestyle, the landscape is overload the trash bins and solid waste piled up into heap.

1.4 Solid waste composition in Malaysia

Households accounted for up to 40% of solid waste load with industrial facilities and construction sites the next two in line. A recent study in Malaysia by Sham Sani (1999), reported that the solid waste composition in Malaysia was dominated by organic waste at 37% followed by paper at 27% and plastic at 16.5% in the total waste stream (Table 1.6).

Table: 1.6: Solid waste composition in Malaysia

Waste composition	Proportion (%)
Organic	37
Paper	27
Plastic	16..5
Glass	3
Metal	4
Others	0.5
Cloths and Rubber	5
Wood	7
Total	100

Source: Sham. Sani (1999).

The organic waste includes kitchen waste, food leftovers, rotten fruit and vegetables and peelings, leaves, gardening trimmings. rags and papers. The inorganic waste includes glass, metal, rubber, wood and others.

1.5 Solid waste management

Solid waste problem in Malaysian cities has become the concern because urban communities cannot cope with overload trash bins, insufficient solid waste disposal services, and no more proper space to accommodate the mounds of incoming solid waste. This predicament not only led to environmental degradation but to the advent of privatised waste management. Recent figures show plastic materials make up 10 to 15 percent of Malaysia's solid waste while packaging materials and paper contribute to another 10 to 15 percent (New Straits Times, 15/4/1997). The packaging industry, through its non-returnable practice, is aggravating the solid waste collection and disposal problem in Kuala Lumpur. The changing social pattern had stimulated a steady growth in the packaging intensity of goods and increases the volume and mass of waste disposal into the landfill. In Kuala Lumpur, the responsibility for solid waste management was within the city authority Dewan Bandaraya Kuala Lumpur (DBKL). Since 1997, waste collection and management in Kuala Lumpur was accomplished by private contractors

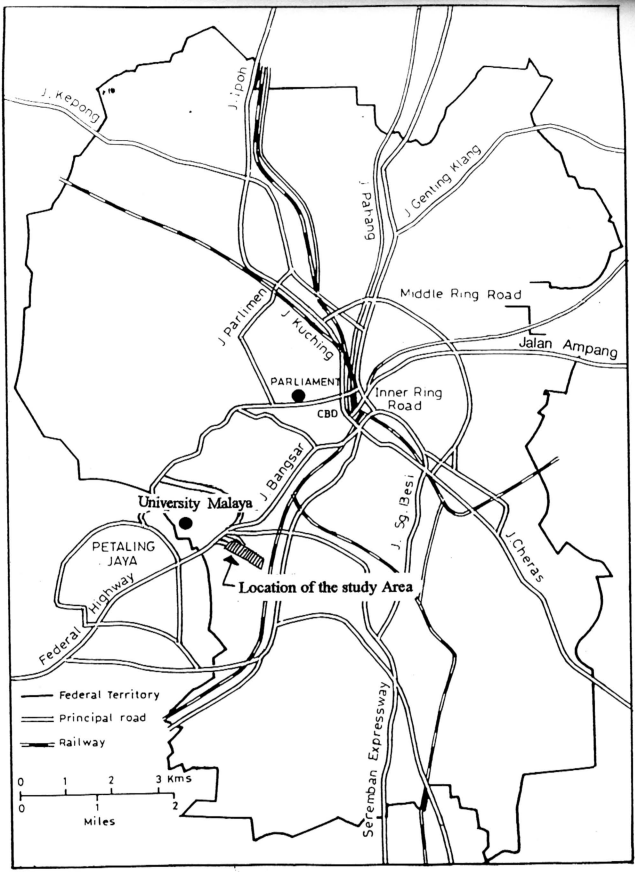
under agreement with the Dewan Bandaraya Kuala Lumpur.. The rapid growth of urban population places a huge strain on the government and municipal agencies to improve municipal services. The annual management of solid waste involved a multimillion-ringgit activity. In Malaysia, inadequate refuse collection services in some urban areas had caused the refuse to accumulate near refuse disposal facilities. Different urban areas (low, middle, and high income; one-story and multi-storey building) have their own specific problems. In low-income areas, collection was less efficient. In high income areas storage problems are less because there is usually no lack of space. A whopping 546 tonnes of rubbish is dumped into illegal garbage sites in Selangor each month (The star, 28/6/1999). There are 230 dumping sites in Malaysia identified in nation and by the way things are going, the dumps are growing by the day (The Star, 28/6/1999). Landfills (open burning, controlled and sanitary) in Malaysia do not have the facility to treat dangerous gases emitted at these sites. The rapid rates of development and urbanization; higher (2 to 3 times) waste density and moisture content, poor accessibility for waste collection due to rural characteristic (squatter settlements, village), congested roads, new areas being developed without appropriate facilities, unsatisfactory waste collection service by local municipal councils, and lack of public cooperation and awareness have made waste management endless and an expensive task.

1.6 Background information of the study areas

The study areas are situated in South West of Federal Territory, Kuala Lumpur (refer to Map 1.1). The Taman Bukit Angkasa settlement and the surrounding areas have population of 9,230 people. The population grows in two main ways: by migration, i.e. people from non-urban areas coming to take up permanent residence in city; and by natural increase, i.e. the excess of births over death of the residence.

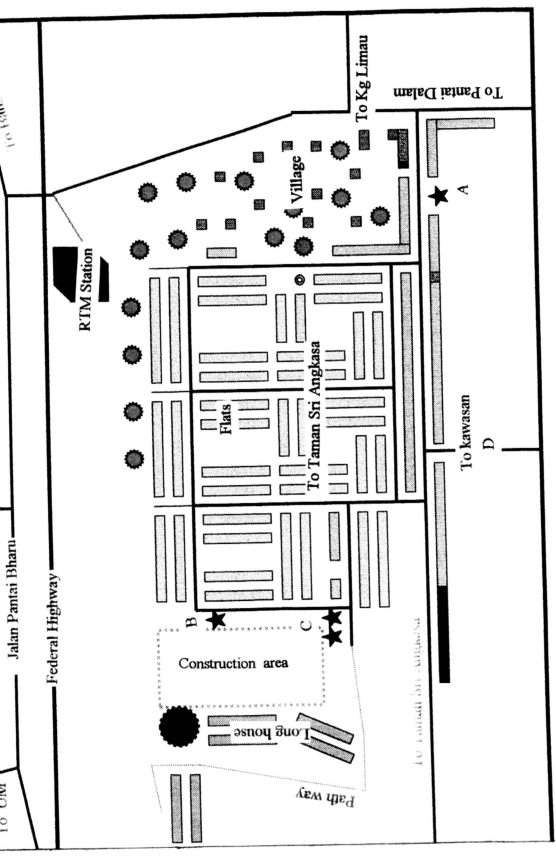
The long house settlement has a population of 1,030 peoples. Around 400 people are living in the squatter settlement. The squatter settlement is a non-conventional housing, which does not comply with the accepted procedures and often does not conform to the legislation. Individuals growing up in this culture are likely to be fatalistic, and feel helpless and inferior. These characteristics, together with the proverty of the family or individual, led to a totally negative view and their role in solid waste management. The Pantai Dalam is a fast growing township and is gearing towards development and going through a high rate of urbanization. The geographical layouts of the settlements are presented in Map 1.2.

In recent years, the production of municipal solid waste in Taman Bukit Angkasa, long houses and in the squatter areas grew considerably both in absolute and



Map 1.1 Location of the study area in Federal Territory of Kuala Lumpur

Map 1.2 Detailed lay out of the housing schemes in the study area



per capita terms. Due to mushrooming of high-rise buildings, which are associated with high population density and standard of living, the amount of the solid waste generation had increased. Stall owners didn't adopt proper waste management methods to protect the quality of life and keep the environment free of pollution.

1.7 Present solid waste status and problems in the study area

The solid waste management in Pantai Dalam is still unsatisfactory because collection and disposal of municipal solid waste is not efficient. People throw garbage in any place although the area is not a dumping ground such as bus stop, open areas, and nearby playgrounds (New Straits Times, 2/2/1998). It is the attitude of some of the residents that makes the area filthy due to the indiscriminate dumping of rubbish. Furthermore, a wide variety of valuable resources are lost in the wastes. Hawker centers churned a large amount of municipal solid waste and it was important to clear them daily. Unclear bins are a common sight. Stagnant water has become a breeding ground for mosquitoes. Other consequences that had resulted include air pollution, and aesthetic problems and destruction of amenity values. Because of the impact on landscape and the accessibility, improper handling of the waste would have serious repercussions. Local authority is incapable of providing efficient solid waste management services.

Detailed waste survey had never been carried out on the solid waste management elements (waste generation rate, the waste stream and its origin, storage, recovery, and collection) in the study area.

It was found that, the local authority do not have any data/information on specific solid waste and national material balance data (for residential, commercial, and institutional) to compare with previous waste generation rate, waste characterization and waste recovery programs. Solid Waste management services are provided by various waste collection agencies, almost all these agencies do not have a proper method of data collection, storage and analysis for their collection areas. They do not carry out analysis of municipal waste or have accurate records of the quantities arising from the various sites. They neither have a proper action plan for MSW improvements. There is little data on the actual quantities of solid waste going to landfill. The information on the waste generation, composition, storage, collection and transportation was obtained through survey conducted.

1.8 Objectives

The objective of the research is to study;

1. waste generation (rate and quantity),

2. waste characteristics including physical, chemical and biological),

3. the possibility of solid waste recovery and waste minimization ; the advantages and disadvantages of the urban solid waste recovery and management will also be investigated,

4. the problems and inefficiencies in the municipal waste management, and

5. the socio- economic aspects on MSW generation characteristic.